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Original Contribution

Alcohol Drinking Patterns and Diet Quality: The 1999–2000 National Health and Nutrition Examination Survey

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Associations between alcohol drinking and cardiovascular disease mortality could be confounded by diet if alcohol drinking and diet are related. Depending on the alcohol measure, alcohol-diet relations may or may not be observed. The authors examined associations between alcohol and diet quality (Healthy Eating Index (HEI) scores) using cross-sectional, nationally representative data from the 1999–2000 National Health and Nutrition Examination Survey. Weighted analyses included 3,729 participants aged ≥20 years. In adjusted analyses among current alcohol drinkers, as quantity increased from 1 to ≥3 drinks/drinking day, the mean HEI score decreased from 65.3 (95% confidence interval (CI): 63.4, 67.1) to 61.9 (95% CI: 60.5, 63.2). As frequency increased from the lowest quartile to the highest, the mean HEI score increased from 60.9 (95% CI: 58.7, 63.2) to 64.9 (95% CI: 63.4, 66.4). As average volume ((quantity × frequency)/365.25) increased from <1 drink/day to ≥3 drinks/day, the mean HEI score increased from 62.9 (95% CI: 61.2, 64.5) to 65.2 (95% CI: 62.7, 67.8). In stratified analyses, the lowest HEI score, 58.5 (95% CI: 55.5, 61.5), occurred among drinkers who consumed the highest quantity at the lowest frequency. Average volume of alcohol consumed is driven by and masks the contributions of its components. These results suggest the importance of measuring drinking patterns (quantity, frequency, and stratified combinations) in epidemiologic alcohol-diet studies.

alcohol drinking; cross-sectional studies; diet; health surveys

Abbreviations: CI, confidence interval; HEI, Healthy Eating Index; NHANES, National Health and Nutrition Examination Survey.

Epidemiologic studies have consistently associated moderate alcohol drinking with decreased risk of cardiovascular disease mortality (1, 2). However, diet could be responsible, at least in part, for these findings. The reason is that diet has been associated with the same outcome (2) and that at least one measure of alcohol consumption, average volume, has been related to certain dietary components (2–11).

Alcohol consumption can be measured in many ways. The measure used may determine whether an association with dietary intake is found. Alcohol consumption consists of two components: the amount consumed on drinking days (quantity) and how often consumption occurs (frequency). Average volume (quantity multiplied by frequency), the summary measure commonly used in epidemiologic studies, does not provide information about drinking patterns (12). Drinking patterns may characterize the association between alcohol consumption and dietary intake in a manner more relevant to chronic disease outcomes than average volume. Drinking patterns have been independently associated with chronic disease risk factors (13–15) and have independently predicted outcomes (16–18). In a recent report, associations between quantity, frequency, and body mass index were obscured by average volume (15). To our

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knowledge, no studies of associations between alcohol and diet have measured drinking patterns.

Dietary intake can also be measured in many ways. The measure used may determine whether an association with alcohol consumption is found. Studies of alcohol consumption and dietary intake (2–11, 19–23) have measured foods, food groups, or nutrients. To our knowledge, only one study (2) has measured diet quality. This overlooked characterization is important because people consume dietary components within the context of total diet, and patterns of dietary intake have been related to health outcomes (24). The Healthy Eating Index (HEI), an approach to characterizing dietary patterns (25–28), is a measure of overall diet quality developed by the US Department of Agriculture to assess and monitor the dietary status of Americans.

The purpose of our study was to determine the association between alcohol drinking patterns and diet quality, as measured by HEI score, in a nationally representative sample of the US population.

MATERIALS AND METHODS

Survey

We used data from the 1999–2000 National Health and Nutrition Examination Survey (NHANES 1999–2000), a continuing, cross-sectional, nationally representative survey of the US noninstitutionalized civilian population that employs a complex, stratified, multistage, probability sample design. A total of 9,965 persons completed an in-person home interview, and 9,282 subsequently completed an interview/examination at a Mobile Examination Center. Response rates were 81.9 percent for the home interview and 76.3 percent for the Mobile Examination Center interview/examination. Details on the methods used in NHANES are available at a Centers for Disease Control and Prevention website (www.cdc.gov/nhanes/).

Measures

Healthy Eating Index. Our dependent variable was the HEI score (25, 28), a measure of diet quality created by the US Department of Agriculture's Center for Nutrition Policy and Promotion. In NHANES 1999–2000, HEI scores were derived from previous-day dietary intake data collected as part of the Mobile Examination Center interview/examination via an interviewer-administered 24-hour recall.

The HEI score is the sum of 10 components representing different aspects of a healthful diet. Each component has a minimum score of zero and a maximum score of 10. Components 1–5 measure a person's conformance to recommended numbers of servings, based on age and gender, for the five major food groups in the 1992 Food Guide Pyramid: grains, vegetables, fruits, milk and milk products, and meat and meat alternates. Components 6–10 measure total fat consumption as a percentage of total energy intake, saturated fat consumption as a percentage of total energy intake, total cholesterol intake, sodium intake (excluding salt added at the table), and dietary variety. The maximum total score is 100, with higher scores indicating healthier diets. A detailed explanation of the scoring method has been published elsewhere (25).

Alcohol consumption. Our independent variable of interest was alcohol consumption. During the Mobile Examination Center interview/examination, persons aged $\geq$20 years were asked the following questions:

- "In any one year, have you had at least 12 drinks of any type of alcoholic beverage?"
- "In your entire life, have you had at least 12 drinks of any type of alcoholic beverage?"
- "In the past 12 months, how often did you drink any type of alcoholic beverage?"
- "In the past 12 months, on those days that you drank alcoholic beverages, on the average how many drinks did you have?"

Persons who had consumed at least 12 drinks in any year or in their entire life, and had consumed alcohol on at least one day in the past year, were considered current drinkers; those who had not were considered nondrinkers.

Alcohol consumption was characterized by three variables. First, quantity (number of drinks consumed, on average, on drinking days) was defined as 1, 2, or $\geq$3 drinks/drinking day. Second, frequency (number of drinking days in the past year) was defined in gender-specific quartiles of consumption. The gender-specific quartiles represented the following drinking frequencies: for men, quartile 1 = 1–12 days/year, quartile 2 = 13–52 days/year, quartile 3 = 53–150 days/year, and quartile 4 = 151–365 days/year; for women, quartile 1 = 1–3 days/year, quartile 2 = 4–12 days/year, quartile 3 = 13–52 days/year, and quartile 4 = 53–365 days/year. Third, average daily volume ((quantity $\times$ frequency)/365.25) was defined as $<$1, 1, 2, or $\geq$3 drinks/day.

Smoking. Smoking status was determined by asking participants, "Have you smoked at least 100 cigarettes in your entire life?" Persons who replied "yes" were subsequently asked, "Do you now smoke cigarettes...?" Those who replied that they smoked "every day" or on "some days" were classified as current smokers. Those who replied "no" were classified as not current smokers.

Physical activity. For physical activity, we adapted the scoring method of Gerrior et al. (29) by creating a leisure physical activity measure which weights self-reported moderate and vigorous leisure activities. The score assesses physical activity status in terms of recommended intensity, duration, and frequency of performance of individual activities, in relation to current guidance on adequate physical activity (engaging in 30 minutes of moderate activity on five or more days per week and/or 20 minutes of vigorous activity on three or more days per week). We categorized the scores as 0 (none), $>$0–$<$100 (some), and $\geq$100 (most), with scores of zero representing no leisure physical activity and scores of $\geq$100 meeting or exceeding guidance.

Other covariates. Other covariates included gender, age (continuous), race (non-Hispanic White, other), education (high school or less, more than high school), and body mass index, calculated as weight in kilograms divided by height in meters squared (continuous).

TABLE 1. Unadjusted weighted mean Healthy Eating Index scores, by alcohol drinking status and demographic and lifestyle factors, National Health and Nutrition Examination Survey, 1999–2000

	Healthy Eating Index score							
	Nondrinkers				Current drinkers			
	No. of subjects*	Mean†	95% CI‡	*p* value§	No. of subjects	Mean	95% CI	*p* value
Total	1,322	63.7	62.2, 65.3		2,407	63.2	61.7, 64.8	
Gender								
Male	550	62.4	60.0, 64.8		1,343	62.7	61.3, 64.1	
Female	772	64.7	63.5, 65.9	0.0154	1,064	63.8	61.8, 65.8	0.1003
Age (years)								
20–24	64	64.4	61.8, 66.9		202	60.9	58.2, 63.6	
25–50	362	61.2	59.9, 62.5		1,168	62.2	60.6, 63.7	
≥51	896	65.4	63.2, 67.7	0.0058	1,037	66.2	64.8, 67.7	<0.0001
Race								
White	542	64.1	62.5, 65.8		1,174	63.6	61.5, 65.6	
Nonwhite	780	62.9	60.9, 64.8	0.1187	1,233	62.3	60.8, 63.9	0.3788
Education								
High school or less	975	62.7	60.9, 64.5		1,309	61.2	59.9, 62.4	
More than high school	341	65.6	64.0, 67.1	0.0024	1,093	64.9	63.1, 66.8	0.0009
Smoking status								
Current smoker	159	58.0	54.6, 61.4		627	58.9	57.7, 60.1	
Not current smoker	1,161	64.7	63.2, 66.2	0.0013	1,775	65.0	63.3, 66.8	<0.0001
Body mass index¶								
≤24.9	352	64.9	62.5, 67.3		826	63.8	62.2, 65.4	
25.0–29.9	441	65.2	63.3, 67.0		868	63.9	62.4, 65.5	
≥30	508	61.8	59.5, 64.2	0.0448	703	61.6	59.8, 63.4	0.0018
Leisure physical activity#								
None	498	62.4	59.9, 65.0		550	61.4	59.8, 63.0	
Some	499	63.6	62.1, 65.0		966	63.0	62.0, 64.1	
Most	278	65.4	63.1, 67.6	0.1682	785	64.3	61.7, 66.8	0.0112

* Numbers may not add up to the total for the full sample because of missing data.
† Excludes pregnant and breastfeeding women.
‡ CI, confidence interval.
§ Global Wald *F* test *p* value.
¶ Weight (kg)/height $(m)^2$.
# See Materials and Methods for explanation.

Sample

There were 9,282 Mobile Examination Center participants (4,562 men, 4,720 women). Of these, 4,444 were aged ≥20 years (2,074 men, 2,370 women). We excluded 317 pregnant or breastfeeding women and 398 participants who were missing data on alcohol consumption, HEI score, or both. Thus, our analytic sample consisted of 3,729 persons (1,893 men, 1,836 women).

Statistical analyses

We weighted the analyses to obtain nationally representative results. We calculated unadjusted mean values and standard errors for HEI scores according to demographic and lifestyle factors and performed Wald *F* tests to test global differences. We used multiple linear regression (30) to obtain unadjusted mean values and standard errors within alcohol categories for both genders combined and separately for men and women. We also used the output from multiple linear regression models to calculate adjusted mean values and standard errors (predictive margins) (31) that were directly standardized to the distribution of each covariate in the model for the entire US population. In multivariable analyses of frequency quartiles, we included quantity categories as a covariate; likewise, in multivariable analyses of quantity categories, we included frequency quartiles.

We tested the significance of differences in HEI scores within alcohol categories using *t* tests of beta coefficients.

TABLE 2. Adjusted weighted mean Healthy Eating Index scores among current alcohol drinkers, by quantity and frequency of alcohol consumed, National Health and Nutrition Examination Survey, 1999–2000

	Healthy Eating Index score							
	Unadjusted				Adjusted*			
	No. of subjects	Mean†	95% CI‡	*p* value	No. of subjects	Mean	95% CI	*p* value
Quantity (no. of drinks, on average, consumed on drinking days)								
1	872	66.5	64.5, 68.4		828	65.3	63.4, 67.1	
2	648	63.2	61.4, 65.0		619	62.7	61.1, 64.3	
≥3	887	60.4	59.0, 61.8		835	61.9	60.5, 63.2	
p for difference (≥3 – 1)		−6.1		<0.0001		−3.4		0.0001
p for trend				<0.0001				0.0002
Frequency (no. of drinking days per year, in quartiles)§								
Q1‡ (low)	592	61.4	59.2, 63.6		561	60.9	58.7, 63.2	
Q2	603	63.3	61.3, 65.4		576	63.4	61.7, 65.1	
Q3	639	62.7	60.5, 65.0		611	63.3	61.1, 65.5	
Q4 (high)	573	65.1	63.6, 66.6		534	64.9	63.4, 66.4	
p for difference (Q4 – Q1)		3.7		0.0301		4.0		0.0247
p for trend				0.0565				0.0358
Average volume (average no. of drinks per day)¶								
<1	1,591	63.3	61.5, 65.1		1,525	62.9	61.2, 64.5	
1	493	62.7	60.9, 64.5		459	62.8	61.0, 64.5	
2	174	64.4	61.9, 66.9		162	65.8	63.4, 68.2	
≥3	149	63.2	61.2, 65.2		136	65.2	62.7, 67.8	
p for difference (≥3 – <1)		−0.1		0.9200		2.3		0.0714
p for trend				0.8471				0.0134

* Analyses were adjusted for gender, age, race, education, smoking, body mass index, and leisure physical activity. Analyses of quantity were additionally adjusted for frequency, and analyses of frequency were additionally adjusted for quantity.

† Excludes pregnant and breastfeeding women.

‡ CI, confidence interval; Q, quartile.

§ Men: Q1 = 1–12 days/year, Q2 = 13–52 days/year, Q3 = 53–150 days/year, and Q4 = 151–365 days/year. Women: Q1 = 1–3 days/year, Q2 = 4–12 days/year, Q3 = 13–52 days/year, and Q4 = 53–365 days/year.

¶ Average volume = (quantity × frequency)/365.25.

We tested the significance of linear trends for HEI scores (using ordinal scores (1, 2, 3, 4), as appropriate, to represent alcohol categories) in multiple regression models in the same manner. We also performed multiple regression analyses to obtain adjusted mean HEI scores for alcohol frequency (gender-specific quartiles) stratified within the three quantity categories. We performed stratified analyses because frequency and quantity alone do not provide sufficient information about the relation between drinking patterns and HEI scores, and interactions are inherently difficult to interpret.

We carried out all analyses using SUDAAN, version 8.0 (32). SUDAAN is statistical software that takes into account survey stratification and clustering in computation of standard errors. Statistical significance was defined as $\alpha < 0.05$; *p* values were two-tailed. All analyses, except for descriptions of demographic and lifestyle factors, included only current drinkers. Excluding nondrinkers made it possible to explore dose-response relations between alcohol consumption and HEI scores.

RESULTS

Sample description

Nondrinkers had a mean HEI score of 63.7 (95 percent confidence interval (CI): 62.2, 65.3) (table 1). Among the nondrinkers, scores were higher among women and among participants who were aged ≥51 years, had more than a high school education, were not current smokers, and were not obese.

Current drinkers had a mean HEI score of 63.2 (95 percent CI: 61.7, 64.8) (table 1). Among the current drinkers, men and women had similar scores. Scores were higher among those who were aged ≥51 years, had more than

TABLE 3. Adjusted weighted mean Healthy Eating Index scores, by gender, among current alcohol drinkers, according to quantity and frequency of alcohol consumed, National Health and Nutrition Examination Survey, 1999–2000

	Healthy Eating Index score															
	Men								Women*							
	Unadjusted				Adjusted†				Unadjusted				Adjusted			
	No. of subjects	Mean	95% CI‡	*p* value	No. of subjects	Mean	95% CI	*p* value	No. of subjects	Mean	95% CI	*p* value	No. of subjects	Mean	95% CI	*p* value
Quantity (no. of drinks consumed, on average, on drinking days)																
1	373	65.8	63.6, 67.9		347	64.1	61.8, 66.4		499	66.9	64.7, 69.2		481	66.2	63.8, 68.5	
2	349	63.0	61.1, 65.0		330	62.2	60.4, 64.1		299	63.4	60.9, 65.9		289	63.1	61.1, 65.2	
≥3	621	61.0	59.5, 62.5		580	62.3	61.3, 63.4		266	59.0	56.9, 61.1		255	60.6	58.2, 63.0	
p for difference (≥3 − 1)		−4.8		0.0008		−1.8		0.1064		−7.9		<0.0001		−5.6		0.0007
p for trend				0.0008				0.1334				<0.0001				0.0007
Frequency (no. of drinking days per year, in quartiles)§																
Q1‡ (low)	300	61.1	58.4, 63.8		280	60.6	58.1, 63.1		292	61.7	59.1, 64.3		281	61.2	58.1, 64.3	
Q2	313	62.7	60.4, 65.1		298	62.9	60.7, 65.1		290	64.0	61.4, 66.5		278	63.9	61.6, 66.2	
Q3	377	61.9	60.2, 63.6		356	62.2	60.5, 64.0		262	63.9	60.3, 67.5		255	64.6	61.2, 68.0	
Q4	353	64.7	63.4, 66.1		323	64.6	63.3, 65.9		220	65.6	63.2, 68.0		211	65.4	63.0, 67.8	
p for difference (Q4 − Q1)		3.6		0.0421		3.9		0.0178		3.9		0.0751		4.2		0.0939
p for trend				0.0523				0.0244				0.1272				0.1137
Average volume (average no. of drinks per day)¶																
<1	737	62.8	60.9, 64.6		700	62.4	60.7, 64.0		854	63.7	61.8, 65.6		825	63.6	61.6, 65.6	
1	343	62.2	60.5, 63.8		317	62.0	60.4, 63.5		150	63.7	60.9, 66.4		142	63.8	60.9, 66.6	
2	130	63.7	60.4, 67.1		118	65.1	62.2, 68.1		44	66.0	62.3, 69.7		44	66.7	62.8, 70.6	
≥3	133	62.8	60.9, 64.8		122	64.0	61.4, 66.6		—#				—#			
p for difference (≥3 − <1)		0.0		0.9799		1.6		0.3060		2.3		0.3129		3.1		0.1962
p for trend				0.8249				0.0906				0.3947				0.2604

* Excludes pregnant and breastfeeding women.

† Analyses were adjusted for gender, age, race, education, smoking, body mass index, and leisure physical activity. Analyses of quantity were additionally adjusted for frequency, and analyses of frequency were additionally adjusted for quantity.

‡ CI, confidence interval; Q, quartile.

§ Men: Q1 = 1–12 days/year, Q2 = 13–52 days/year, Q3 = 53–150 days/year, and Q4 = 151–365 days/year. Women: Q1 = 1–3 days/year, Q2 = 4–12 days/year, Q3 = 13–52 days/year, and Q4 = 53–365 days/year.

¶ Average volume = (quantity × frequency)/365.25.

Estimate suppressed; analyses were unstable because of small cells (16 women for unadjusted analysis, 14 women for adjusted analysis).

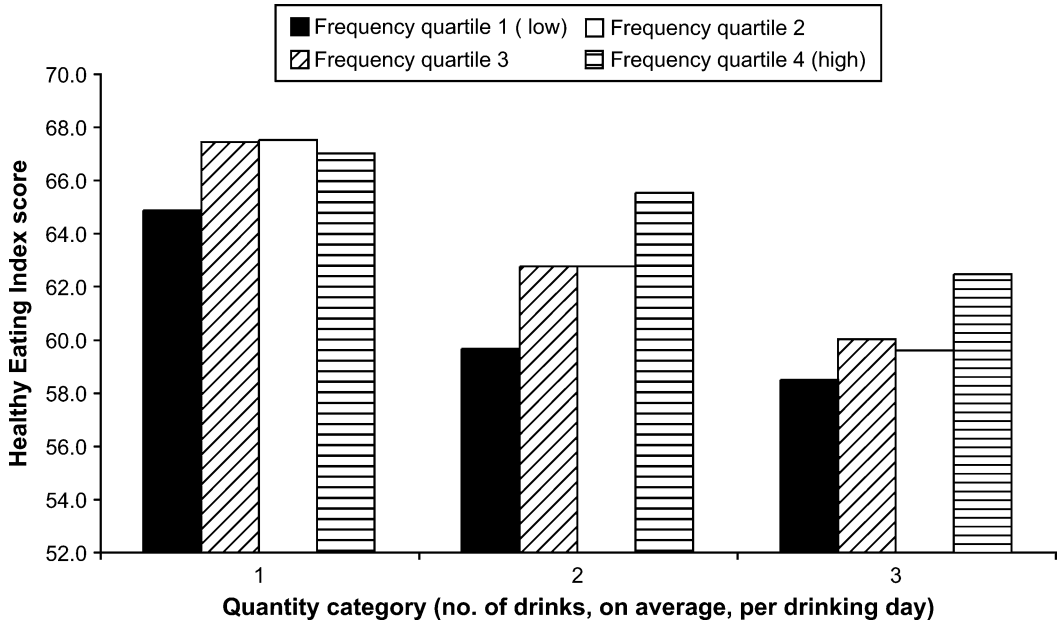

FIGURE 1. Association between alcohol consumption and Healthy Eating Index scores in men and women combined in a stratified analysis of gender-specific frequency quartiles within quantity categories, National Health and Nutrition Examination Survey, 1999–2000.

a high school education, were not current smokers, were not obese, and engaged in the most leisure physical activity.

Multivariable models

The results presented below are based on adjusted analyses among current drinkers.

Quantity. In men and women combined, current drinkers who consumed $\geq$3 drinks/drinking day had a significantly lower mean HEI score than those who consumed 1 drink/drinking day; the linear trend was inverse and significant (table 2). Results were directionally similar in gender-specific analyses (table 3). However, the linear trend was significant only in women.

Frequency. In men and women combined, current drinkers in the highest gender-specific quartile of frequency had a significantly higher mean HEI score than those in the lowest quartile; the linear trend was positive and significant (table 2). Results were directionally similar in gender-specific analyses (table 3). However, the linear trend was significant only in men.

Average volume. In men and women combined, HEI scores were not significantly different between current drinkers in the highest category of average volume compared with the lowest category; however, the linear trend was positive and significant (table 2). Gender-specific results were nonsignificant (table 3).

Stratified analyses

Results for stratified analyses are presented in figure 1. In men and women combined, within each quantity stratum, the mean HEI score was lowest in the least frequent drinkers (quartile 1) and higher in more frequent drinkers. However, the linear trend was significant only within the 2 drinks/drinking-day stratum ($p = 0.0107$), where the HEI score was 59.7 (95 percent CI: 56.5, 62.8) in the least frequent drinkers (quartile 1) as compared with 65.5 (95 percent CI: 64.0, 67.0) in the most frequent drinkers (quartile 4), a difference of 5.8 units (p for difference $= 0.0052$).

The lowest mean HEI score, 58.5 (95 percent CI: 55.5, 61.5), was observed among drinkers who consumed the highest quantity at the lowest frequency, while the highest scores, 67.5 (95 percent CI: 64.9, 70.1) and 67.4 (95 percent CI: 64.5, 70.3), were observed among drinkers who consumed the lowest quantity in the second and third quartiles of frequency.

Stratified analyses were not performed by gender because of small sample sizes.

DISCUSSION

In this nationally representative study of the association between alcohol consumption and diet quality, the measure used to characterize alcohol consumption determined whether an association was found and its direction. As alcohol quantity increased, diet quality worsened. As alcohol frequency increased, diet quality improved. Diet quality was poorest among the highest-quantity, lowest-frequency drinkers and best among the lowest-quantity, higher-frequency drinkers.

Average volume has been the measure of choice in most epidemiologic studies of alcohol, including studies of the

relation between total alcohol consumption and dietary intake (2–11, 23). If the direction of an outcome depends on whether alcohol is measured as quantity or frequency, representing alcohol as average volume (quantity multiplied by frequency) may obscure important associations. Our results suggest that future studies of diet quality measured by the HEI score should measure alcohol as quantity, frequency, and stratified combinations.

Our finding that persons who consumed lower quantities of alcohol had healthier diets is in concordance with the 2005 US Dietary Guidelines (2, 33) recommendation that persons who drink alcohol should do so in moderation—up to one drink per day for women and up to two drinks per day for men. It is important to note that the recommendation addresses only the quantity of alcohol consumed on drinking days. It states: ''The definition of moderation is not intended as an average over several days but as the amount consumed on any single day'' (33, p. 43).

Our study had several limitations. As in any cross-sectional analysis, cause-and-effect cannot be inferred from our results. Our analyses were restricted to NHANES 1999–2000 because HEI data for NHANES 2001–2002 were not available at the time of analysis. Our sample sizes were relatively small for gender-specific analyses. Despite that constraint, men and women had directionally similar results for quantity, frequency, and average volume. However, quantity trends were significant only for women, and frequency trends were significant only for men. With additional power from a larger sample, it is possible that all trends would be significant in both men and women. NHANES 1999–2000 collected only 1 day of data on dietary intake, so our mean HEI scores were measured with error due to day-to-day variability in eating. This measurement error would have attenuated associations between diet quality and measures of alcohol and reduced the likelihood of finding relations.

Our analyses did not consider beverage-specific intake of alcohol. Studies suggest that the apparently protective effects of alcoholic beverages on cardiovascular disease appear to be related more to alcohol per se and to drinking patterns than to consumption of specific types of alcoholic beverages (34, 35). Moreover, beverage-specific data in NHANES 1999–2000 were not comparable with total alcohol consumption data; quantity was not assessed, and frequency was assessed over a shorter duration.

We also did not consider patterns of weekend versus weekday alcohol consumption or consumption with meals. We recognize that diet is one of many factors that could confound studies of alcohol-cardiovascular disease outcomes. We decided to focus in depth on diet quality as measured by the HEI. Additional studies are needed to determine whether the relations we found between alcohol quantity and frequency and HEI score are generalizable to other measures of dietary intake. Investigators in future studies might consider examining associations between quantity and frequency of alcohol consumption and other potential confounders of alcohol-cardiovascular disease outcomes—for example, physical activity.

Our study had several strengths. Few in-depth epidemiologic studies of the association between alcohol and diet have been performed in US populations (2, 3, 5, 22), and none, to our knowledge, have been nationally representative. Although data presented in the 2005 US Dietary Guidelines report (2) were nationally representative, they were descriptive estimates. Our study employed a widely used measure of diet quality, the HEI score. HEI scores have been correlated with dietary variety and fruit, fat, and saturated fat intakes (26) and with plasma biomarkers of fruit and vegetable intake (26, 27). HEI scores have also been associated with obesity (36). Modified HEI scores calculated from food frequency questionnaires (as opposed to dietary recalls) have been associated with reduced risk of incident cardiovascular disease in men (37) and reduced risk of fatal or nonfatal cardiovascular disease in women (38).

Our study was about the relation between alcohol and diet quality, not the relation between alcohol and cardiovascular disease mortality. However, the former may inform the latter. Clarifying the relation between alcohol consumption and diet quality, as well as other measures of dietary intake, is an important step in determining the extent to which diet is a confounder in studies of alcohol and cardiovascular disease outcomes. In our study, when average volume was measured, associations with dietary intake were masked. When the components of average volume, quantity and frequency, were measured separately, associations became more evident. This, in turn, suggests that the way in which alcohol consumption and dietary intake are measured in studies of cardiovascular disease outcomes may determine the extent to which confounding can be controlled and residual confounding avoided.

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